

THAT WHICH IS CLAIMED:

1. An isolated nucleotide molecule comprising a nucleotide sequence selected from the group consisting of:
  - 5 (a) the nucleotide sequence set forth in SEQ ID NO: 1;
  - (b) a nucleotide sequence which encodes a polypeptide comprising the amino acid sequence set forth in SEQ ID NO: 2;
  - (c) a nucleotide sequence comprising at least 75% identity to the nucleotide sequence set forth in SEQ ID NO: 1;
  - 10 (d) a nucleotide sequence encoding a polypeptide having acyl-CoA thioesterase activity, wherein said nucleotide sequence comprises at least 24 contiguous bases of the nucleotide sequence set forth in SEQ ID NO: 1; and
  - (e) a nucleotide sequence complementary to the nucleotide sequence of (a), (b), or (c).
2. An expression cassette comprising at least one nucleotide molecule of claim 1 operably linked to a promoter that drives expression in a plant cell.
- 20 3. The expression cassette of claim 3, wherein said promoter is selected from the group consisting of seed-preferred promoters, chemical-regulatable promoters, constitutive and germination-preferred promoters.
4. An isolated protein comprising a polypeptide selected from the group consisting of:
  - 25 (a) a polypeptide comprising the amino acid sequence set forth in SEQ ID NO: 2;
  - (b) a polypeptide having acyl-CoA thioesterase activity, said polypeptide comprising at least 75% identity to an amino acid sequence set forth in SEQ ID NO: 2; and

(c) a polypeptide encoded by a nucleotide sequence set forth in SEQ ID NO: 1.

5. A method for decreasing  $\beta$ -oxidation in a plant comprising transforming at least one cell of said plant with a nucleotide construct comprising an acyl-CoA thioesterase nucleotide sequence or fragment thereof, said nucleotide sequence selected from the group consisting of:

- (a) the nucleotide sequence set forth in SEQ ID NO: 1;
- (b) a nucleotide sequence which encodes a polypeptide comprising the amino acid sequence set forth in SEQ ID NO: 2;
- (c) a nucleotide sequence comprising at least 75% identity to the nucleotide sequence set forth in SEQ ID NO: 1;
- (d) a nucleotide sequence encoding a polypeptide having acyl-CoA thioesterase activity, wherein said nucleotide sequence comprises at least 24 contiguous bases of the nucleotide sequence set forth in SEQ ID NO: 1;
- (e) the nucleotide sequence having GenBank Accession No. AF124264;
- (f) the nucleotide sequence having GenBank Accession No. AF124265; and
- (g) a nucleotide sequence complementary to a nucleotide sequence of (a), (b), (c), (e), or (f);

wherein the level of oil or the level of at least one constituent of said oil is increased in at least one part of said plant.

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6. The method of claim 5 further comprising antisense suppression, cosuppression, or chimeroplasty.

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8. The method of claim 5, wherein said acyl-CoA thioesterase is peroxisomal acyl-CoA thioesterase.

9. The method of claim 5, wherein said nucleotide construct further 5 comprises a promoter that drives expression a plant cell operably linked to said acyl-CoA thioesterase nucleotide sequence.

10. The method of claim 9, wherein said promoter is selected from the group 10 consisting of seed-preferred, constitutive, chemically regulatable and developmentally regulated promoters.

11. The method of claim 9, wherein said nucleotide construct further comprises an operably linked nucleotide sequence encoding a peroxisome-targeting signal.

15 12. The method of claim 5, wherein said constituent is selected from the group of consisting of unusual fatty acids, unusual fatty acyl chains and triacylglycerols with at least one unusual fatty acyl chain.

20 13. The method of claim 5, wherein said plant produces at least one unusual fatty acid.

25 14. The method of claim 13, wherein said fatty acid is selected from the group consisting of vernolic acid, petroselinic acid, sterculic acid, lesquerolic acid, densipolic acid, auricolic acid, *cis*-5-eicosenoic acid, *cis*-5-docosenoic acid, *cis*-5,13-docosdienoic acid, chaulmoogric acid, erucic acid, ricinoleic acid, labellenic acid, crepenynic acid and stearolic acid.

15. The method of claim 5 further comprising decreasing in at least one cell of said plant the level or activity of at least one protein selected from the group consisting of acyl-CoA oxidase and multifunctional protein type II.

5 16. The method of claim 5 further comprising transforming at least one cell of said plant at least one additional nucleotide construct comprising a nucleotide sequence encoding a protein or fragment thereof, said protein selected from the group consisting of acyl-CoA oxidase and multifunctional protein type II.

10 17. The method of claim 5 further comprising regenerating said cell into a transformed plant.

15 18. A method for optimizing a plant for seed oil production comprising: transforming at least one cell of said plant with a first nucleotide construct comprising a first nucleotide sequence or fragment thereof, so as to increase or decrease acyl-CoA thioesterase expression in a seed, said first nucleotide sequence selected from the group consisting of:

20 (a) the nucleotide sequence set forth in SEQ ID NO: 1,  
(b) a nucleotide sequence which encodes a polypeptide comprising the amino acid sequence set forth in SEQ ID NO: 2,  
(c) a nucleotide sequence comprising at least 75% identity to the nucleotide sequence set forth in SEQ ID NO: 1,  
(d) a nucleotide sequence encoding a polypeptide having acyl-CoA thioesterase activity, wherein said nucleotide sequence comprises at least 24 contiguous bases of the nucleotide sequence set forth in SEQ ID NO: 1,  
(e) the nucleotide sequence having GenBank Accession No. AF124264,  
(f) the nucleotide sequence having GenBank Accession No. AF124265, and

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(g) a nucleotide sequence complementary to a nucleotide sequence of (a), (b), (c), (e), or (f); and transforming said cell with a second nucleotide construct comprising a second nucleotide sequence or fragment thereof, so as to decrease the level or activity of acyl-CoA oxidase or multifunctional protein type II in a seed, said second nucleotide sequence selected from the group consisting of an acyl-CoA oxidase nucleotide sequence or a multifunctional protein type II nucleotide sequence;

wherein the level of oil or the level of at least one constituent of said oil is increased in at least one part of said seed.

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19. The method of claim 18, wherein at least one of said first and said second nucleotide constructs further comprises an operably linked promoter that drives expression a plant cell.

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20. The method of claim 19, wherein said at least one of said first and said second nucleotide constructs further comprises an operably linked nucleotide sequence encoding a peroxisome-targeting signal.

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21. A transformed plant comprising in its genome a stably incorporated nucleotide construct comprising a promoter that drives expression a plant operably linked to a nucleotide sequence encoding an acyl-CoA thioesterase, said nucleotide sequence selected from the group consisting of:

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- (a) the nucleotide sequence set forth in SEQ ID NO: 1;
- (b) a nucleotide sequence which encodes a polypeptide comprising the amino acid sequence set forth in SEQ ID NO: 2;
- (c) a nucleotide sequence comprising at least 75% identity to the nucleotide sequence set forth in SEQ ID NO: 1;
- (d) a nucleotide sequence encoding a polypeptide having acyl-CoA thioesterase activity, wherein said nucleotide sequence comprises

at least 24 contiguous bases of the nucleotide sequence set forth in SEQ ID NO: 1;

- (e) the nucleotide sequence having GenBank Accession No. AF124264;
- 5 (f) the nucleotide sequence having GenBank Accession No. AF124265; and
- (g) a nucleotide sequence complementary to a nucleotide sequence of (a), (b), (c), (e), or (f);

wherein the level of said acyl-CoA thioesterase is decreased or increased in said  
10 plant or part thereof.

22. The plant of claim 21, wherein said acyl-CoA thioesterase is a peroxisomal acyl-CoA thioesterase.

15 23. The plant of claim 21 further comprising in its genome at least one additional stably incorporated nucleotide construct comprising a promoter that drives expression in a plant cell operably linked to a nucleotide sequence comprising a coding sequence for a protein selected from the group consisting of an acyl-CoA oxidase, and a multifunctional protein type II.

20 24. The plant of claim 21, wherein said plant is capable of producing at least one unusual fatty acyl chain in its seeds.

25 25. The plant of claim 21, wherein said plant is a monocot.

26. The plant of claim 25, wherein said monocot is selected from the group consisting of maize, wheat, rice, sorghum, barley, millet, rye and palm.

30 27. The plant of claim 21, wherein said plant is a dicot.

28. The plant of claim 27, wherein said dicot is selected from the group consisting of soybean, *Brassica*, alfalfa, safflower, sunflower, cotton, flax, peanut and potato.

5 29. Transformed seed of the plant of claim 21.

30. A transformed plant cell comprising in its genome a stably incorporated nucleotide construct comprising a promoter that drives expression a plant operably linked to a nucleotide sequence encoding an acyl-CoA thioesterase, said nucleotide sequence selected from the group consisting of:

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(a) the nucleotide sequence set forth in SEQ ID NO: 1;  
(b) a nucleotide sequence which encodes a polypeptide comprising the amino acid sequence set forth in SEQ ID NO: 2;  
(c) a nucleotide sequence comprising at least 75% identity to the nucleotide sequence set forth in SEQ ID NO: 1;  
(d) a nucleotide sequence encoding a polypeptide having acyl-CoA thioesterase activity, wherein said nucleotide sequence comprises at least 24 contiguous bases of the nucleotide sequence set forth in SEQ ID NO: 1;  
(e) the nucleotide sequence having GenBank Accession No. AF124264;  
(f) the nucleotide sequence having GenBank Accession No. AF124265; and  
(g) a nucleotide sequence complementary to a nucleotide sequence of (a), (b), (c), (e), or (f);

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wherein the level of said acyl-CoA thioesterase is decreased or increased in said plant cell.

31. A transformed plant comprising stably incorporated in its genome:

- (a) a first nucleotide construct comprising a first promoter that drives expression a plant operably linked to a first nucleotide sequence comprising a coding sequence for an acyl-CoA thioesterase; and
- 5 (b) a second nucleotide construct comprising a second promoter that drives expression a plant operably linked to a second nucleotide sequence comprising a coding sequence for an acyl-CoA oxidase, or a multifunctional protein type II;

wherein the level of said acyl-CoA thioesterase is decreased or increased in said

10 plant or part thereof.

32. The plant of claim 31, wherein said first nucleotide sequence is selected from the group consisting of:

- (a) the nucleotide sequence set forth in SEQ ID NO: 1;
- (b) a nucleotide sequence which encodes a polypeptide comprising the amino acid sequence set forth in SEQ ID NO: 2;
- (c) a nucleotide sequence comprising at least 75% identity to the nucleotide sequence set forth in SEQ ID NO: 1;
- (d) 20 a nucleotide sequence encoding a polypeptide having acyl-CoA thioesterase activity, wherein said nucleotide sequence comprises at least 24 contiguous bases of the nucleotide sequence set forth in SEQ ID NO: 1;
- (e) the nucleotide sequence having GenBank Accession No. AF124264;
- (f) 25 the nucleotide sequence having GenBank Accession No. AF124265; and
- (g) a nucleotide sequence complementary to a nucleotide sequence of (a), (b), (c), (e), or (f).

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33. The plant of claim 31, wherein said acyl-CoA thioesterase is a peroxisomal acyl-CoA thioesterase.

34. Transformed seed of the plant of claim 31.

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35. A transformed plant cell comprising stably incorporated in its genome:

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- (a) a first nucleotide construct comprising a first promoter that drives expression a plant operably linked to a first nucleotide sequence comprising a coding sequence for an acyl-CoA thioesterase; and
- (b) a second nucleotide construct comprising a second promoter that drives expression a plant operably linked to a second nucleotide sequence comprising a coding sequence for an acyl-CoA oxidase, or a multifunctional protein type II;

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wherein the level of said acyl-CoA thioesterase is decreased or increased in said plant cell.

36. The plant cell of claim 35, wherein said first nucleotide sequence is selected from the group consisting of:

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- (a) the nucleotide sequence set forth in SEQ ID NO: 1;
- (b) a nucleotide sequence which encodes a polypeptide comprising the amino acid sequence set forth in SEQ ID NO: 2;
- (c) a nucleotide sequence comprising at least 75% identity to the nucleotide sequence set forth in SEQ ID NO: 1;
- (d) a nucleotide sequence encoding a polypeptide having acyl-CoA thioesterase activity, wherein said nucleotide sequence comprises at least 24 contiguous bases of the nucleotide sequence set forth in SEQ ID NO: 1;
- (e) the nucleotide sequence having GenBank Accession No. AF124264;

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- (f) the nucleotide sequence having GenBank Accession No. AF124265; and
- (g) a nucleotide sequence complementary to a nucleotide sequence of (a), (b), (c), (e), or (f).

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